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PTO/SB/05 (2/98)
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Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1 53(b))

Attorney Docket No.	080398.P288
First Inventor or Application Identifier	Sukendeep Samra
Title	SYSTEM AND METHOD FOR DYNAMIC AUTOCROPPING OF IMAGES
Express Mail Label No.	EL634502008US

JC675 U.S. PTO 09/18/00

JC675 U.S. PTO 09/665721 09/18/00

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents

ADDRESS TO: Assistant Commissioner for Patents
Box Patent Application
Washington, DC 20231

1. [X] Fee Transmittal Form *(e.g. PTO/SB/17)*
(Submit an original, and a duplicate for fee processing)
2. [X] Specification Total Pages 20
(preferred arrangement set forth below)
- Descriptive title of the Invention
- Cross References to Related Applications
- Statement Regarding Fed sponsored R & D
- Reference to Microfiche Appendix
- Background of the Invention
- Brief Summary of the Invention
- Brief Description of the Drawings *(if filed)*
- Detailed Description
- Claim(s)
- Abstract of the Disclosure

3. [X] Drawing(s) *(35 U.S.C.113)* Total Sheets 4
4. Oath or Declaration Total Pages 4
   a. [X] Newly executed (original copy)
   b. [ ] Copy from a prior application (37 CFR 1.63(d))
   (for continuation/divisional with Box 16 completed)
   i. [ ] DELETION OF INVENTOR(S)
   Signed statement attached deleting inventor(s) named in the prior application, see 37 CFR 1.63(d)(2) and 1.33(b).

5. [ ] Microfiche Computer Program *(Appendix)*
6. Nucleotide and/or Amino Acid Sequence Submission
(if applicable, all necessary)
   a. [ ] Computer Readable Copy
   b. [ ] Paper Copy (identical to computer copy)
   c. [ ] Statement verifying identity of above copies

NOTE FOR ITEMS 1 & 13 IN ORDER TO BE ENTITLED TO PAY SMALL ENTITY FEES, A SMALL ENTITY STATEMENT IS REQUIRED (37 C.F.R. § 1.27), EXCEPT IF ONE FILED IN A PRIOR APPLICATION IS RELIED UPON (37 C.F.R. § 1.28).

ACCOMPANYING APPLICATION PARTS

7. [X] Assignment Papers (cover sheet & document(s))
8. [ ] 37 CFR 3.73(b) Statement *(when there is an assignee)* [ ] Power of Attorney
9. [ ] English Translation Document *(if applicable)*
10. [ ] Information Disclosure Statement (IDS)/PTO - 1449 [ ] Copies of IDS Citations
11. [ ] Preliminary Amendment
12. [ ] Return Receipt Postcard (MPEP 503)
(Should be specifically itemized)
13. [ ] *Small Entity Statement(s) [ ] Statement filed in prior application, Status still proper and desired
14. [ ] Certified Copy of Priority Document(s)
(if foreign priority is claimed)
15. [ ] Other: . . . . . .

16. **If a CONTINUING APPLICATION**, *check appropriate box, and supply the requisite information below and in a preliminary amendment:*
[ ] Continuation [ ] Divisional [ ] Continuation-in-part (CIP) of prior application No: ____/____
Prior application Information: Examiner ____ *Group/Art Unit:* ____
For CONTINUATION or DIVISIONAL APPS only: The entire disclosure of the prior application, from which an oath or declaration is supplied under Box 4b, is considered a part of the disclosure of the accompanying continuation or divisional application and is hereby incorporated by reference. The incorporation can only be relied upon when a portion has been inadvertently omitted from the submitted application parts.

17. CORRESPONDENCE ADDRESS

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Name	BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP				
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Name (Print/Type)	Eric S. Hyman, Reg. No. 30,139		
Signature		Date	09/18/00

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FEE TRANSMITTAL

Petent fees are subject to annual revision on October 1. These are the fees effective October 1, 1997. Small Entity payments must be supported be a small entity statement, otherwise large entity fees must be paid. See Forms PTO/SB/09-12. See 37 C.F.R. §§ 1.28 and 1.28

TOTAL AMOUNT OF PAYMENT ($) 1126.00

Complete if Known	
Application Number	
Filing Date	09/18/00
First Named Inventor	Sukendeep Samra
Examiner Name	
Group Art Unit	
Attorney Docket Number	080398.P288

METHOD OF PAYMENT (check one)

1. ☒ The Commissioner is hereby authorized to charge indicated fees and credit any over payments to:

Deposit Account Number: 02-2666

Deposit Account Name: Blakely, Sokoloff, Taylor & Zafman LLP

☒ Charge Any Additional Fee Required Under 37 CFR 1.16 and 1.17 ☐ Charge the Issue Fee Set in 37 CFR 1.18 at the Mailing of the Notice of Allowance.

2. ☒ Payment Enclosed:
☒ Check ☐ Money Order ☐ Other

FEE CALCULATION (fees effective 10/01/96)

1. FILING FEE

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
101	690	201	345	Utility filing fee	$690
106	310	206	155	Design filing fee	
107	480	207	240	Plant filing fee	
108	690	208	345	Reissue filing fee	
114	150	214	75	Provisional filing fee	

SUBTOTAL (1) ($) 690.00

2. EXTRA CLAIM FEES

	Extra Claims		Fee from below		Fee Paid
Total Claims 42	-20** = 22	X	$18.00	=	396.00
Independent Claims 3	-3** = 0	X	$78.00	=	0.00
Multiple Dependent				=	

***or number of previously paid, if greater; For Reissues, see below*

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description
103	18	203	9	Claims in excess of 20
102	78	202	39	Independent claims in excess of 3
104	270	204	135	Multiple Dependent claim
109	78	209	39	**Reissue independent claims over original patent
110	18	210	9	**Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) ($) 396.00

FEE CALCULATION (continued)

3. ADDITIONAL FEE

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
105	130	205	65	Surcharge - late filing fee or oath	
127	50	227	25	Surcharge - late provisional filing fee or cover sheet.	
139	130	139	130	Non-English specification	
147	2,520	147	2,520	For filing a request for reexamination	
112	920*	112	920*	Requesting publication of SIR prior to Examiner action	
113	1,840*	113	1,840*	Requesting publication of SIR after Examiner action	
115	110	215	55	Extension for response within first month	
116	380	216	190	Extension for response within second month	
117	870	217	435	Extension for response within third month	
118	1,360	218	680	Extension for response within fourth month	
128	1,850	228	925	Extension for response within fifth month	
119	300	219	150	Notice of Appeal	
120	300	220	150	Filing a brief in support of an appeal	
121	260	221	130	Request for oral hearing	
138	1,360	138	1,360	Petition to institute a public use proceeding	
140	110	240	55	Petition to revive - unavoidably	
141	1,210	241	605	Petition to revive - unintentionally	
142	1,210	242	605	Utility issue fee (or reissue)	
143	430	243	215	Design issue fee	
144	580	244	290	Plant issue fee	
122	130	122	130	Petitions to the Commissioner	
123	50	123	50	Petitions related to provisional applications	
126	240	126	240	Submission of Information Disclosure Stmt	
581	40	581	40	Recording each patent assignment per property (times number of properties)	40
146	760	246	380	Filing a submission after final rejection (37 CFR 1.129(a))	
149	760	249	380	For each additional invention to be examined (37 CFR 1.129(b))	

Other fee (specify) _____

Other fee (specify) _____

* Reduced by Basic Filing Fee Paid

SUBTOTAL (3) ($) 40.00

SUBMITTED BY

				Complete (if applicable)	
Typed or Printed Name	Eric S. Hyman, Reg. No. 30,139			Reg. Number	
Signature		Date	09/18/00	Deposit Account User ID	02-2666

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Attorney's Docket No. 080398.P288 Express Mail No: EL634502008US

UNITED STATES PATENT APPLICATION

FOR

SYSTEM AND METHOD FOR DYNAMIC AUTOCROPPING OF IMAGES

Inventor:

Sukendeep Samra

DOCKET NO. 080398.P288

Prepared by:

BLAKELY SOKOLOFF TAYLOR & ZAFMAN LLP
12400 Wilshire Boulevard, Seventh Floor
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(310) 207-3800

SYSTEM AND METHOD FOR DYNAMIC AUTOCROPPING OF IMAGES

Field of the Invention

The present invention relates to the field of computer graphics, compositing images, and adding special effects to images.

Background

Color images are defined by many pixels. Pixels are the building blocks of an image and are often defined by a three component description comprised of red, green and blue components commonly referred to as RGB. A fourth component called alpha is often added resulting in an RGBA description of pixels. Alpha refers to the opacity (or transparency) of a pixel. The standard alpha component is an eight bit value providing 256 levels of opacity from 0-255, where 0 is fully transparent and 255 is full opacity amounting to non-transparency. Alpha is popularly used in compositing images for feature films and other video presentations.

Compositing images is the combining of more than one image to create a single new image. Compositing of images can be performed with a single image frame, such as photograph or a sequence of images, such as film or movies. For example an image of a fish could be combined with the image of a grassy field so that the fish is swimming in the grass. Alpha is used to relate the fish image to the grass. For example, if the fish is placed on the grass and the grass is completely opaque (alpha = 255), no grass will be seen through the fish. If the fish has an alpha of 0, the grass image will seep through the fish so that the fish cannot be seen. Alpha values in between produce differing degrees of a grassy fish. A fish swimming through the grass could be created by compositing a single image frame of a grassy field and a sequence of images created by filming a fish swimming in the ocean. Alternatively, two (or more) sequences of images can be composited, such as a sequence of images of a wind blown grassy field and a sequence of images of a school of fish swimming through the ocean. In addition, the school of fish and/or the grassy field can also have been created in an animation program. Moreover, the ocean area surrounding filmed fish could be obliterated by giving the surroundings (that is, everything but the fish) an opacity of 0, setting the surroundings to have no opacity.

Compositing also includes the techniques of enhancing a sequence of images captured on film by adding special effects, computer generated images, still images, animation and other filmed images to a motion picture. Compositing is used to enhance a sequence of film thus creating a new sequence of images. Special effects, computer

generated images, still images, animation and other filmed images are combined with film by compositing to create a new sequence of images.

One popular use for compositing includes the use of blue screen image sequences. In what is known as "blue screening," an actor is filmed in front of a blue (or green) screen. The alpha values of the background in such an image can be automatically set to transparent, having an opacity of 0. The blue screened sequence of images is then composited with other sequences of images. For example, a street vendor selling watches shot against a blue screen could be composited with a city street scene with English language signs behind him to create one sequence of image, while the same vendor sequence could be composited with Spanish language signs at one of Spain's *costa del sol* beach resorts to create a second sequence of images. More striking effects such as compositing sequences of images to show an actor riding a prehistoric dinosaur can be achieved in a similar manner.

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SUMMARY

The present invention provides a system and method for automatically reading a plurality of images from sequences of images from a specified location, automatically cropping each of the images to produce active region data for the current image, and automatically designating key frames in the sequences of images. In one embodiment, a stand-alone program that achieves these tasks produces an output file comprised of active region data for key frames of all sequences of images. In such an embodiment, the output file serves as a script or control file which a compositing program runs to initially process sequences of images. In another embodiment, these automatic tasks are achieved via a plug-in module to a compositing program such that the plug-in module is run before performing other tasks. The automation of these three formerly manual tasks increases the efficiency of compositing programs by providing automatically pre-processed sequences of images from which to start the compositing process. In addition, autocropping allows for better use of system resources and improves system performance by causing the system to only load smaller, autocropped images of key frames.

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BRIEF DESCRIPTION OF THE DRAWINGS

The features and advantages of the present invention will become apparent from the following detailed description of the present invention in which:

Figure 1 depicts a system and environment in which the method of the present invention is executed.

Figure 2 depicts the flow of initial steps automatically performed according to the method of the present invention when starting to create a video presentation with compositing software applications.

Figure 3 depicts a more detailed view of the flow of one embodiment of the initial steps automatically performed according to the method of the present invention when starting to create a video presentation with a compositing software application.

Figures 4a and 4b depict two methods of embodiments of autocropping.

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DETAILED DESCRIPTION

When creating a movie, sequences of images are traditionally shot with a camera, developed and edited to create a finished product. Special effects have been added to films in many ways. More recently, with the availability of high powered computers, computer software programs are increasingly used to assist in the creation of movies, television shows, and other video presentations whether originating from animation or live action camera shots. To clarify various qualities of the present invention, the phrase video presentation includes sequences of images such as film, movies, animation, features, shorts, and the like created by digital film or video footage, digitized film or video input, computer generated images, hand drawn images, still images such as photographs and the compositing of each of these including the adding of effects. In addition, the phrase sequence of images includes any sequence of images created by filming, videotaping, still photography, computer generated images such as animation, hand drawn images such as animation, and the like.

Computer programs used in manipulating sequences of images for producing video presentations are compositing programs commonly referred to as effects software or digital effects software. Examples of such programs include Media Illusion® available from the Softimage™ division of Avid Technology, Inc., One Park West, Tewksbury, Massachusetts 01876; Chalice, available from Silicon Grail Corporation, 710 Seward Street, Hollywood, California 90038, and the Maya and Studio series of programs, available from Alias|Wavefront®, 210 King Street East, Toronto, Ontario, Canada M5A 1J7.

When starting to use a compositing program, sequences of images stored in a variety of formats are input. Common formats of digital images used in producing video presentations include Alias|Wavefront's RLA format (more information is available from Alias|Wavefront®, 210 King Street East, Toronto, Ontario, Canada M5A 1J7), Silicon Graphic's SGI format (more information is available from Silicon Graphics, Inc., 1600 Amphitheatre Parkway, Mountain View, California 94043), and Kodak's Cineon digital film format (more information is available from Eastman Kodak Company, Rochester, New York).

Figure 1 depicts a system and environment in which the method of the present invention is executed. A compositing program is executed on computer 1. The computer comprises a processor 2 to execute the compositing program. Processor 2 may be any computer processor known to those skilled in the art. When executing the compositing program, the processor utilizes memory 3. Memory 3 may be any form of volatile random access memory (RAM) known to those skilled in the art. The compositing program accesses sequences of images from storage device 4. Storage device 4 may be a writeable

disk drive known to those skilled in the art such as, for example, a hard disk or a readable and writeable compact disk (CDRW). When the compositing program reads an image or sequence of images from the disk drive, the processor may communicate instructions to graphics controller 5 to display the images on display device 6. Graphics controller 6 may be any graphics controller known to those skilled in the art, and display device 6 may be any display monitor known to those skilled in the art, including, but not limited to, a cathode ray tube (CRT) display monitor, or thin film transistor (TFT) display screen. A user accesses the compositing program running on computer 1 via any computer input device known to those skilled in the art, such as, for example keyboard 7 and mouse 8 which are coupled to the processor by an input/output (I/O) controller 9.

To access images not stored on computer 1, computer 1 includes a network access unit 10 which allows the compositing program to communicate over network 14 to remote computer 15 and access images stored on remote storage device 16. Network 14 may be a local area network (LAN), wide area network (WAN), or any other kind of network known to those skilled in the art. Remote computer 15 may be any kind of computer known to those skilled in the art, including, but not limited to, personal computers, specialty graphics workstations, and servers. Remote storage device 16 may be any readable storage medium known to those skilled in the art such as, for example, hard disk drives and CDRWs. Although only one remote computer and one network are depicted, multiple remote computers over multiple networks may be connected to computer 1. Processor 2, memory 3, storage device 4, graphics controller 5, I/O controller 9 and network access unit 10, are coupled to one another via and communicate with one another over bus 11. Bus 11 may be any bus known to those skilled in the art. Although only one bus is depicted, multiple buses may be used in computer 1. In addition, other internal components known to those skilled in the art (not depicted) or multiple instances of depicted components may be included in computer 1.

The initial steps taken when using compositing programs typically include a user manually designating each sequence of images that will be combined. The user then often manually crops images and manually selects what is known in the art as key frames, single images of a sequence of images that meet certain criteria. Key frames are image frames of a sequence of images which are important to the sequence of images and include the first image of a sequence of images, and image frames which are substantially different from the prior image frame. Key frames are discussed in more detail below.

Figure 2 depicts the flow of initial steps automatically performed according to one embodiment of the method of the present invention when starting to create a video presentation with a compositing software application. The present invention provides a method for automatically reading images from sequences of images from a specified directory or directories as shown in block 20, automatically cropping each of the images as

shown in block 22, and automatically designating key frames in the sequences of images as shown in block 24. The automation of these three formerly manual tasks increases the efficiency of users of compositing programs by providing automatically pre-processed sequences of images from which to start. In addition, autocropping allows for better use of system resources and improves system performance by causing the system to only load autocropped images of key frames. This increased performance is achieved by the system loading fewer images, only key frames rather than all image frames of a sequence of images, and only loading the autocropped key frames which are smaller than full images. That is, as a cropped image is smaller, comprises a smaller area, it is defined by less data than a full image.

Software written to automatically read sequences of images, automatically crop the images, and automatically designate key frames may be implemented a variety of ways. In one embodiment, the software is implemented as a plug-in or a module within a compositing program. In an alternate embodiment, the software may be implemented as a stand-alone pre-processing tool or utility program. In one embodiment, the automatic cropping and other steps can be included as a plug-in or module with a compositing program such that the plug-in is executed upon start up of the compositing program or is executed as a first step when using the compositing program. In another embodiment, the automatic cropping and other steps can be achieved via a separate stand-alone program which is run in advance of starting a compositing program such that the stand-alone program creates a script or control file which the compositing program runs to initially process sequences of images. In such an embodiment, the stand-alone program functions as a pre-processing program that is run on sequences of images before a user begins using the features of the compositing program.

Figure 3 depicts a more detailed view of the flow of initial steps automatically performed according to one embodiment of the method of the present invention when starting to create a video presentation with a compositing software application. In one embodiment, to automatically read sequences of images, automatically crop the images, and automatically designate key frames, a stand-alone pre-processing program is evoked via a command line interface taking various parameters as input. In one embodiment, parameters include boundary, a smoothness factor, input file location, output file location. (Boundary and smoothness factor are discussed in more detail below.) The input parameters are obtained as shown in step 30. The first image of the first sequence of images in the specified directory is then read and set as the current image as shown in block 32. The current image is then autocropped, as shown in block 38, producing active region data for the current image. In one embodiment, during autocropping, only cropping data, that is, active region data, is produced; in this embodiment, no changes are made to the current

image during autocropping. Further details of one embodiment of autocropping are set forth below with regard to **Figures 4a and 4b**.

After autocropping the current image, a user specified boundary, if any, is added to the active region of the current image, as shown in block 40. As with autocropping, no changes are made to the current image; only the active region data is updated. In another embodiment, a default or machine preset boundary, or no boundary is added to the active region. In one embodiment, the pre-processing software allows the user to set the boundary to between 0 and 20 pixels, and defaults to a boundary of 10 pixels if no boundary value is specified.

A check is then made to determine whether the current image is a first image of the current sequence of images, as shown in block 42. If the current image is a first image, the current image is designated as a key frame, as shown in block 48. If the current image is not a first image, a check is made to determine whether the active region of the current image is inside the prior image's active region, as shown in block 44. If not, the current image is designated as a key frame, as shown in block 48. If the active region of the current image is inside the prior image's active region, a comparison is then made to determine if smoothing is needed, as shown in block 46.

Smoothing relates to how different the image frames are from their neighboring image frames in a particular sequence of image frames. More specifically, when a sequence of images is displayed over time, the resulting viewed images can appear smooth or disjointed depending on how similar the image frames comprising the sequence are to one another. The smoothing factor is a value representing the threshold by which one frame can differ from its neighbors. In one embodiment, smoothing is needed when the difference in area (in square pixels) between the active region of the current image and the active region of the prior image is greater than the smoothing factor value input by the user. If smoothing is needed, then the current image is designated a key frame, as shown in block 48. In another embodiment, a default or machine preset smoothing factor, or no smoothing factor is provided. In one embodiment, the pre-processing software allows the user to set the smoothing factor to between 0 and 20 pixels, and defaults to a smoothing factor of 5 pixels if no smoothing factor value is specified.

If the current image is a first image, if the active region of the current image is not inside the prior image's active region, or if smoothing is needed, the current frame is designated as a key frame, as shown in block 48. If the current image is a key frame, the active region data for the current frame is stored so that it is later included in the output file when pre-processing has completed. The output file only contains active region data for images designated as key frames.

If smoothing is not needed or after the current image has been designated a key frame, a check is made as to whether there are any further images; that is, a check is made

as to whether there is a next image, as shown in block 50. As part of this checking, if there is a next image, the next image is read. Reading the next image includes, storing the current image and its active region data as the prior image and active region of the prior image, and reading the next image of the current sequence of images and setting it to be the current image. As this point, if there are no further images in the current sequence of images, the next sequence of images is obtained from the user specified directory. If there is a next image, autocropping is performed at block 38, and the flow continues as previously described. If there are no further images in the current sequence of images and there are no further sequences of images, then an output file is prepared containing data that defines the active regions for all of the images of all of the sequences of images that were designated as key frames, as shown in block 60. The output file can then be used as an input file to a compositing program.

Figures 4a and 4b depict two methods of autocropping. Generally, autocropping determines the active region of a current image frame. In one embodiment, an active region is a region surrounded by pixels that are fully transparent or pixels that have no opacity. In other embodiments, an active region is a region surrounded by pixels that are outside a certain opacity threshold that may be either pre-defined by the system or user defined. In yet other embodiments, a determination of opacity for a pixel is made by analyzing pixels surrounding the current pixel to create an average which is then compared to a threshold opacity. In such embodiments, a function that returns 0 when the pixel is within the threshold opacity and 1 when the pixel is outside the threshold opacity may be used. Such a function would, in some embodiments take into consideration the opacity values of pixels neighboring the current pixel. Traditionally, opacity is an 8 bit value, but in other embodiments, opacity may be an alpha component that is a 16 bit, 32 bit, 64 bit or any other bit size variable the particular hardware system supports. In addition, in other embodiments, it follows that opacity as measured by an alpha value may increase in range from 0 to 255 to a range correlating to the bit size used to represent alpha values, such as, for example, 0 to 65,536 for a 16 bit representation.

Figure 4a depicts one method of autocropping an image frame. After the current image is read, as shown in block 70, the left-most vertical line of the current image with opacity is located, as shown in block 72. In one embodiment, this is achieved by starting at pixel 0,0, the origin of the image, and proceeding up and down vertical lines to the right until a line with opacity is found such that the prior line has no opacity. The x coordinate of the left-most vertical line with opacity defines the left border of the active region of the current image. Similarly, the right-most vertical line of the current image with opacity is located, as shown in block 74. In one embodiment, this is achieved by starting at the pixel corresponding to the horizontal and vertical resolution of the image (*e.g.*, pixel 800, 600 for an image frame with 800 x 600 resolution) and proceeding down and up vertical lines to

the left (no further than the left border) until a line with opacity is found such that the prior line has no opacity. The x coordinate of the right-most vertical line with opacity defines the right border of the active region of the current image.

The top and bottom borders of the active region of the current image are then located. The top-most horizontal line of the current image with opacity is located, as shown in block 76. In one embodiment, this is achieved by starting at the pixel with the x coordinate corresponding to the left border and the y coordinate corresponding to the image vertical resolution (*e.g.*, pixel left border, 600 for an image frame with 800 x 600 resolution) and proceeding left and right across horizontal lines between the left border and right border toward the bottom until a line with opacity is found such that the prior line has no opacity. Processing pixels between the left border and right border increases computational efficiency as pixels outside the borders are not examined. The y coordinate of the top-most horizontal line with opacity defines the top border of the active region of the current image.

The bottom-most horizontal line of the current image with opacity is then located, as shown in block 78. In one embodiment, this is achieved by starting at the pixel with the x coordinate corresponding to the left border and the y coordinate corresponding to 0 (i.*e.*, pixel left border, 0) and proceeding left and right across horizontal lines between the left border and right border toward the top border until a line with opacity is found such that the prior line has no opacity. As above, processing pixels between the left border and right border increases computational efficiency. The y coordinate of the bottom-most horizontal line with opacity defines the bottom border of the active region of the current image.

Data representing the active region of the current image is then stored, as shown in block 80. The data stored are the left border, right border, top border and bottom borders of the active region of the current image.

Figure 4b depicts another method of autocropping an image frame. After the current image is read, as shown in block 90, the top-most horizontal line of the current image with opacity is located, as shown in block 92. In one embodiment, this is achieved by starting at the pixel with an x coordinate corresponding to 0 and a y coordinate corresponding to the vertical resolution of the image (*e.g.*, 0, 600 for an image frame with 800 x 600 resolution) and proceeding right and left across horizontal lines toward the bottom until a line with opacity is found such that the prior line has no opacity. The y coordinate of the top-most horizontal line with opacity defines the top border of the active region of the current image. Similarly, the bottom-most horizontal line of the current image with opacity is located, as shown in block 94. In one embodiment, this is achieved by starting at the pixel corresponding to coordinates 0, 0 and proceeding right and left across horizontal lines toward the top (no further than the top border) until a line with opacity is found such that the prior line has no opacity. The y coordinate of the bottom-most

horizontal line with opacity defines the bottom border of the active region of the current image.

The left and right borders of the active region of the current image are then located. The left-most vertical line of the current image with opacity is located, as shown in block 96. In one embodiment, this is achieved by starting at the pixel with x coordinate corresponding to 0 and y coordinate corresponding to the bottom border (*i.e.,* pixel at 0, bottom border) and proceeding up and down through vertical lines between the bottom border and top border to the right until a line with opacity is found such that the prior line has no opacity. Processing pixels between the bottom border and top border increases computational efficiency as pixels outside the borders are not examined. The x coordinate of the left-most vertical line with opacity defines the left border of the active region of the current image.

The right-most vertical line of the current image with opacity is then located, as shown in block 98. In one embodiment, this is achieved by starting at the pixel with the x coordinate corresponding to the horizontal resolution of the image and the y coordinate corresponding to the bottom border (*e.g.,* pixel 800, bottom border for an image frame with 800 x 600 resolution) and proceeding up and down through vertical lines between the bottom border and top border toward the left border until a line with opacity is found such that the prior line has no opacity. As above, processing pixels between the top border and bottom border increases computational efficiency. The x coordinate of the right-most horizontal line with opacity defines the right border of the active region of the current image.

Data representing the active region of the current image is then stored, as shown in block 100. The data stored are the left border, right border, top border and bottom borders of the active region of the current image.

While certain exemplary embodiments have been described and shown in the accompanying drawings, it is to be understood that such embodiments are merely illustrative of and not restrictive on the broad invention, and that this invention not be limited to the specific constructions and arrangements shown and described, since various other modifications may occur to those ordinarily skilled in the art.

CLAIMS

What is claimed is:

1. A method comprising:
reading at least one sequence of images;
preparing autocrop data for each image of each of the sequences of images; and
storing autocrop data for each key frame of the sequences of images.

2. The method of Claim 1 wherein preparing autocrop data comprises:
determining the active region of a current image of the sequences of images.

3. The method of Claim 2 wherein determining the active region comprises:
selecting a portion of the current image as the active region of the current image such that all pixels outside the active region have no opacity.

4. The method of Claim 3 wherein selecting a portion comprises:
reading the current image;
locating a first vertical line of pixels with at least one pixel having non-zero opacity closest to the origin of the image;
locating a second vertical line of pixels with at least one pixel having non-zero opacity furthest from the origin of the image;
locating a first horizontal line of pixels with at least one pixel having non-zero opacity closest to the origin of the image;
locating a second horizontal line of pixels with at least one pixel having non-zero opacity furthest from the origin of the image; and
storing data specifying the active region of the current image.

5. The method of Claim 4 wherein
locating the first vertical line and locating the second vertical line are performed before locating the first horizontal line and locating the second horizontal line; and
locating the first horizontal line and locating the second horizontal line each comprise examining pixels between the first vertical line and the second vertical line.

6. The method of Claim 4 wherein
locating the first horizontal line and locating the second horizontal line are performed before locating the first vertical line and locating the second vertical line; and
locating the first vertical line and locating the second vertical line each comprise examining pixels between the first horizontal line and the second horizontal line.

7. The method of Claim 4 wherein storing data specifying the active region of the current image comprises:

storing the x coordinate of the first vertical line, the x coordinate of the second vertical line, the y coordinate of the first horizontal line, and the y coordinate of the second horizontal line.

8. The method of Claim 1 further comprising:

determining which images of each of the sequences of images are key frames.

9. The method of Claim 8 wherein determining comprises:

determining whether the current image is the first frame of one of the sequences of images, and, if so, designating the current image as a key frame;

determining whether the active region of the current image is outside the active region of a prior image, and, if so, designating the current image as a key frame; and

determining whether smoothing is needed, and, if so, designating the current image as a key frame.

10. The method of Claim 9 wherein determining whether smoothing is needed comprises:

calculating the difference in area between the active region of the current image and the active region of the prior image; and

comparing the difference in area with a smoothing factor.

11. The method of Claim 10 wherein the smoothing factor is a numerical value set by a user.

12. The method of Claim 9 wherein the active region is a portion of any image such that all pixels outside the active region of the image have no opacity.

13. The method of Claim 2 further comprising:

adding a boundary to the active region of the current image.

14. The method of Claim 13 wherein the boundary is a numerical value set by a user.

15. A machine readable medium having stored thereon instructions which when executed by a processor cause the machine to perform operations comprising:

reading at least one sequence of images;

preparing autocrop data for each image of each of the sequences of images; and

storing autocrop data for each key frame of the sequences of images.

16. The machine readable medium of Claim 15 wherein preparing autocrop data causes the machine to perform operations comprising:

determining the active region of a current image of the sequences of images.

17. The machine readable medium of Claim 16 wherein determining the active region data causes the machine to perform operations comprising:

selecting a portion of the current image as the active region of the current image such that all pixels outside the active region have no opacity.

18. The machine readable medium of Claim 17 wherein selecting a portion causes the machine to perform operations comprising:

reading the current image;

locating a first vertical line of pixels with at least one pixel having non-zero opacity closest to the origin of the image;

locating a second vertical line of pixels with at least one pixel having non-zero opacity furthest from the origin of the image;

locating a first horizontal line of pixels with at least one pixel having non-zero opacity closest to the origin of the image;

locating a second horizontal line of pixels with at least one pixel having non-zero opacity furthest from the origin of the image; and

storing data specifying the active region of the current image.

19. The machine readable medium of Claim 18 wherein:

locating the first vertical line and locating the second vertical line are performed before locating the first horizontal line and locating the second horizontal line; and

locating the first horizontal line and locating the second horizontal line each comprise examining pixels between the first vertical line and the second vertical line.

20. The machine readable medium of Claim 18 wherein:

locating the first horizontal line and locating the second horizontal line are performed before locating the first vertical line and locating the second vertical line; and

locating the first vertical line and locating the second vertical line each comprise examining pixels between the first horizontal line and the second horizontal line.

21. The machine readable medium of Claim 18 wherein storing data specifying the active region of the current image causes the machine to perform operations comprising:

storing the x coordinate of the first vertical line, the x coordinate of the second vertical line, the y coordinate of the first horizontal line, and the y coordinate of the second horizontal line.

22. The machine readable medium of Claim 15 having stored thereon further instructions which when executed by the processor cause the machine to perform further operations comprising:

determining which images of each of the sequences of images are key frames.

23. The machine readable medium of Claim 22 wherein determining causes the machine to perform operations comprising:

determining whether the current image is the first frame of one of the sequences of images, and, if so, designating the current image as a key frame;

determining whether the active region of the current image is outside the active region of a prior image, and, if so, designating the current image as a key frame; and

determining whether smoothing is needed, and, if so, designating the current image as a key frame.

24. The machine readable medium of Claim 23 wherein determining whether smoothing is needed causes the machine to perform operations comprising:

calculating the difference in area between the active region of the current image and the active region of the prior image; and

comparing the difference in area with a smoothing factor.

25. The machine readable medium of Claim 24 wherein the smoothing factor is a numerical value set by a user.

26. The machine readable medium of Claim 23 wherein the active region is a portion of any image such that all pixels outside the active region of the image have no opacity.

27. The machine readable medium of Claim 16 having stored thereon further instructions which when executed by the processor cause the machine to perform further operations comprising:

adding a boundary to the active region of the current image.

28. The machine readable medium of Claim 13 wherein the boundary is a numerical value set by a user.

29. A system comprising:

a processor coupled to a bus;

a memory coupled to the bus;

a storage device coupled to the bus, the storage device having stored thereon instructions which when executed by the processor cause the system to perform operations comprising:

reading at least one sequence of images;

preparing autocrop data for each image of each of the sequences of images; and

storing autocrop data for each key frame of the sequences of images on the storage device.

30. The system of Claim 29 wherein preparing autocrop data causes the system to perform operations comprising:

determining the active region of a current image of the sequences of images.

31. The system of Claim 30 wherein determining the active region data causes the system to perform operations comprising:

selecting a portion of the current image as the active region of the current image such that all pixels outside the active region have no opacity.

32. The system of Claim 31 wherein selecting a portion causes the system to perform operations comprising:

reading the current image;

locating a first vertical line of pixels with at least one pixel having non-zero opacity closest to the origin of the image;

locating a second vertical line of pixels with at least one pixel having non-zero opacity furthest from the origin of the image;

locating a first horizontal line of pixels with at least one pixel having non-zero opacity closest to the origin of the image;

locating a second horizontal line of pixels with at least one pixel having non-zero opacity furthest from the origin of the image; and

storing data specifying the active region of the current image.

33. The system of Claim 32 wherein:

locating the first vertical line and locating the second vertical line are performed before locating the first horizontal line and locating the second horizontal line; and

locating the first horizontal line and locating the second horizontal line each comprise examining pixels between the first vertical line and the second vertical line.

34. The system of Claim 32 wherein:

locating the first horizontal line and locating the second horizontal line are performed before locating the first vertical line and locating the second vertical line; and

locating the first vertical line and locating the second vertical line each comprise examining pixels between the first horizontal line and the second horizontal line.

35. The system of Claim 32 wherein storing data specifying the active region of the current image causes the system to perform operations comprising:

storing the x coordinate of the first vertical line, the x coordinate of the second vertical line, the y coordinate of the first horizontal line, and the y coordinate of the second horizontal line.

36. The system of Claim 29 having further instructions which when executed by the processor cause the system to perform further operations comprising:

determining which images of each of the sequences of images are key frames.

37. The system of Claim 36 wherein determining causes the system to perform operations comprising:

determining whether the current image is the first frame of one of the sequences of images, and, if so, designating the current image as a key frame;

determining whether the active region of the current image is outside the active region of a prior image, and, if so, designating the current image as a key frame; and

determining whether smoothing is needed, and, if so, designating the current image as a key frame.

38. The system of Claim 37 wherein determining whether smoothing is needed causes the system to perform operations comprising:

calculating the difference in area between the active region of the current image and the active region of the prior image; and

comparing the difference in area with a smoothing factor.

39. The system of Claim 37 wherein the active region is a portion of any image such that all pixels outside the active region of the image have no opacity.

40. The system of Claim 39 having stored thereon further instructions which when executed by the processor cause the system to perform further operations comprising:

adding a boundary to the active region of the current image.

41. The system of Claim 29 wherein reading at least one sequence of images comprises:

transferring at least one sequence of images from the storage device to the memory.

42. The system of Claim 29 wherein reading at least one sequence of images comprises:

transferring at least one sequence of images from a remote storage device via a network.

ABSTRACT

A system and method for automatically reading all images from all sequences of images from a specified location, automatically cropping each of the images to produce active region data for the current image, and automatically designating key frames in the sequences of images. In one embodiment, a stand-alone program that achieves these tasks produces an output file comprised of active region data for key frames of all sequences of images. In such an embodiment, the output file serves as a script or control file which a compositing program runs to initially process sequences of images. In another embodiment, these automatic tasks are achieved via a plug-in module to a compositing program such that the plug-in module is run before performing other tasks. The automation of these three formerly manual tasks increases the efficiency of compositing programs by providing automatically pre-processed sequences of images from which to start the compositing process. In addition, autocropping allows for better use of system resources and improves system performance by causing the system to only load smaller, autocropped images of key frames.

0605.0.0 = 12/5/95

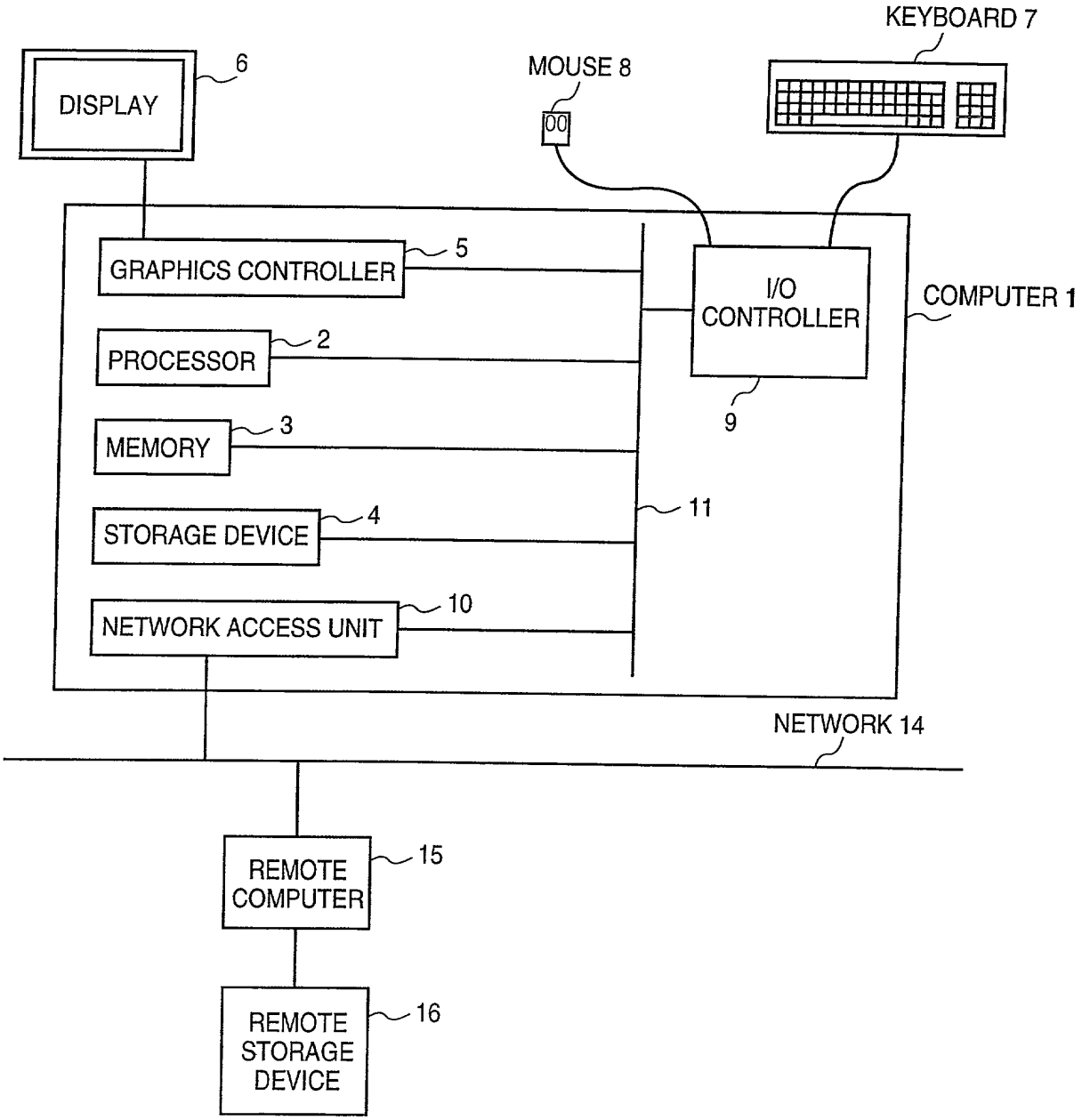
KEYBOARD 7
DISPLAY
6
MOUSE 8
GRAPHICS CONTROLLER
5
I/O CONTROLLER
COMPUTER 1
PROCESSOR
2
9
MEMORY
3
11
STORAGE DEVICE
4
NETWORK ACCESS UNIT
10
NETWORK 14
REMOTE COMPUTER
15
REMOTE STORAGE DEVICE
16

FIG. 1

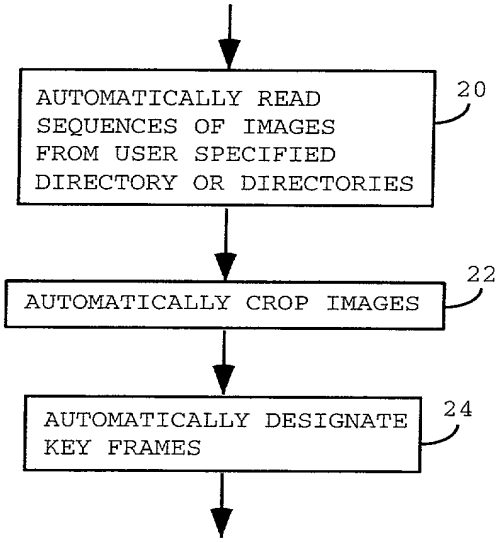
AUTOMATICALLY READ SEQUENCES OF IMAGES FROM USER SPECIFIED DIRECTORY OR DIRECTORIES
20
AUTOMATICALLY CROP IMAGES
22
AUTOMATICALLY DESIGNATE KEY FRAMES
24

FIG. 2

D-95525/2 06/09/2004

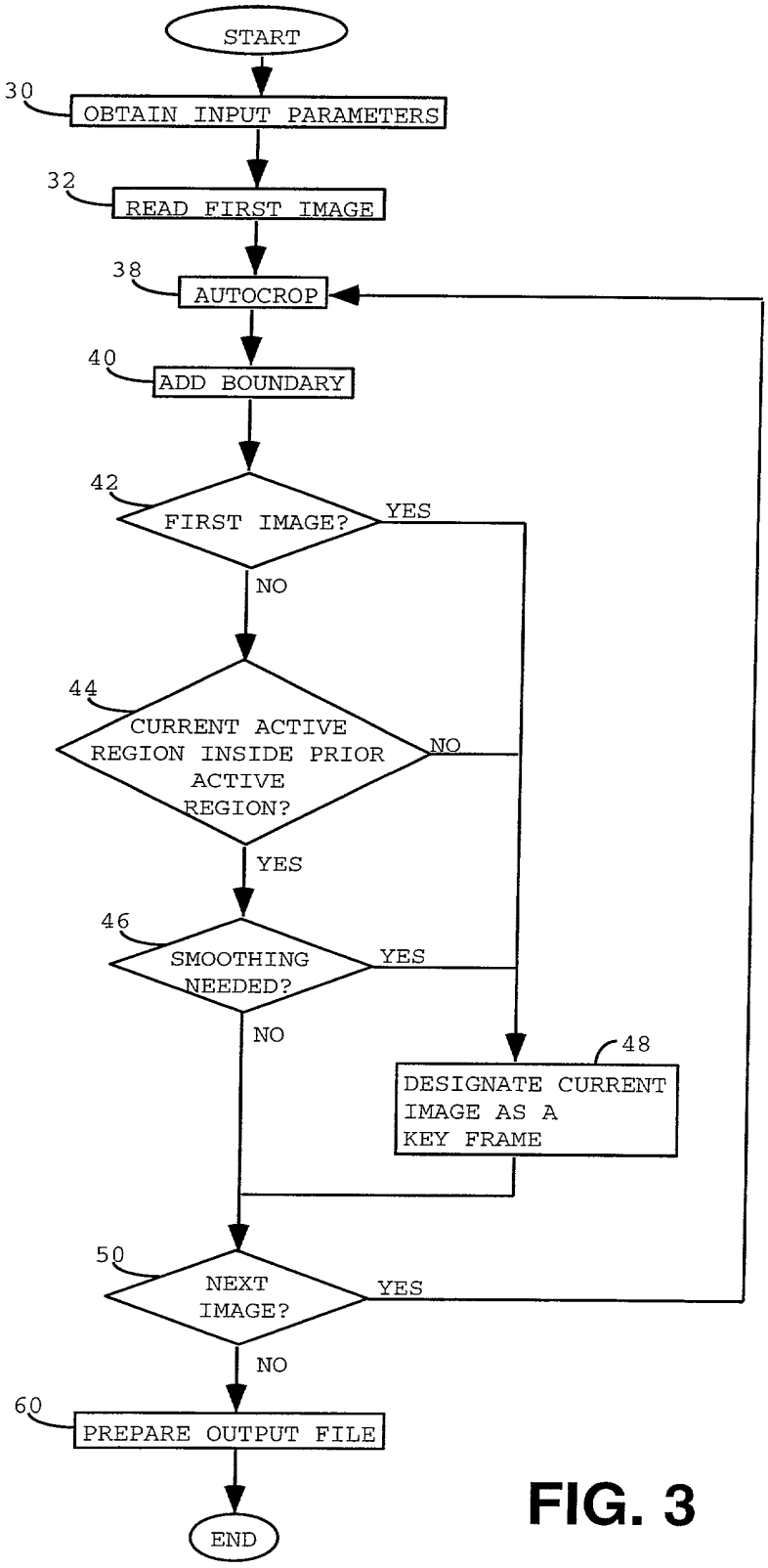

FIG. 3

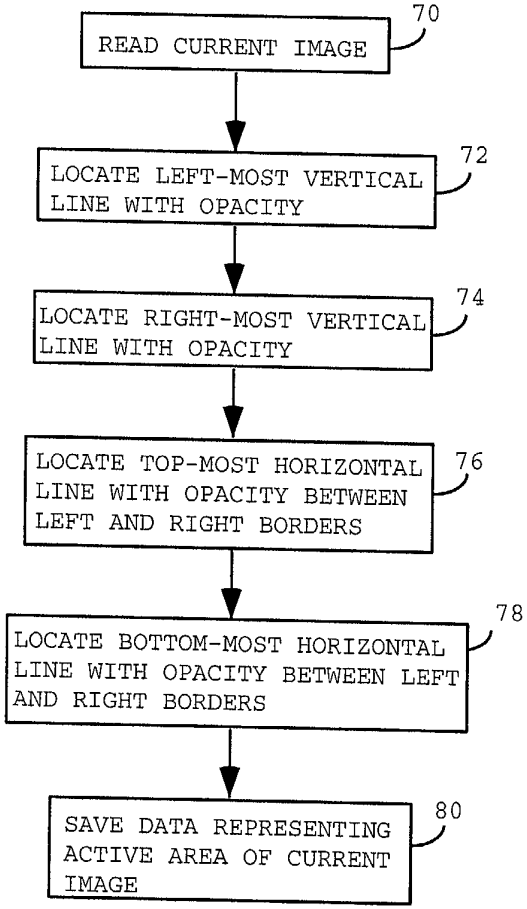
READ CURRENT IMAGE
70
LOCATE LEFT-MOST VERTICAL LINE WITH OPACITY
72
LOCATE RIGHT-MOST VERTICAL LINE WITH OPACITY
74
LOCATE TOP-MOST HORIZONTAL LINE WITH OPACITY BETWEEN LEFT AND RIGHT BORDERS
76
LOCATE BOTTOM-MOST HORIZONTAL LINE WITH OPACITY BETWEEN LEFT AND RIGHT BORDERS
78
SAVE DATA REPRESENTING ACTIVE AREA OF CURRENT IMAGE
80

FIG. 4A

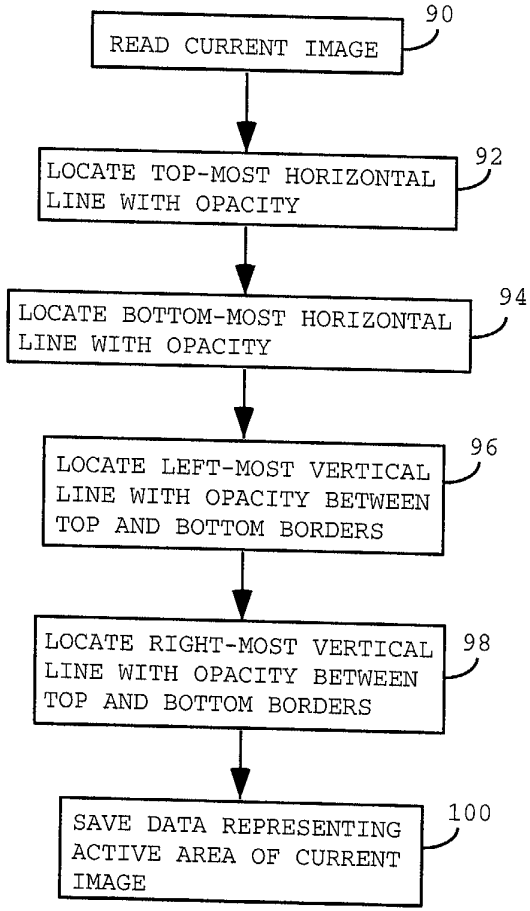
READ CURRENT IMAGE
90
LOCATE TOP-MOST HORIZONTAL LINE WITH OPACITY
92
LOCATE BOTTOM-MOST HORIZONTAL LINE WITH OPACITY
94
LOCATE LEFT-MOST VERTICAL LINE WITH OPACITY BETWEEN TOP AND BOTTOM BORDERS
96
LOCATE RIGHT-MOST VERTICAL LINE WITH OPACITY BETWEEN TOP AND BOTTOM BORDERS
98
SAVE DATA REPRESENTING ACTIVE AREA OF CURRENT IMAGE
100

FIG. 4B

Attorney's Docket No.: 080398.P288 PATENT

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below, next to my name.

I believe I am the original, first, and sole inventor (if only one name is listed below) or an original, first, and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled
SYSTEM AND METHOD FOR DYNAMIC AUTOCROPPING OF IMAGES

the specification of which

__X__ is attached hereto.
_____ was filed on _____ as
United States Application Number _____
or PCT International Application Number_____
and was amended on _____.
(if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claim(s), as amended by any amendment referred to above.

I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119(a)-(d), of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)			Priority Claimed	
Number	Country	Day/Month/Year Filed	Yes	No
Number	Country	Day/Month/Year Filed	Yes	No
Number	Country	Day/Month/Year Filed	Yes	No

Express Mail Label No. EV339025705US

I hereby claim the benefit under Title 35, United States Code, Section 119(e) of any United States provisional application(s) listed below:

Application Number	Filing Date

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, Section 112, I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

Application Number	Filing Date	Status -- patented, pending, abandoned

I hereby appoint the persons listed on Appendix A hereto (which is incorporated by reference and a part of this document) as my respective patent attorneys and patent agents, with full power of substitution and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected herewith.

Send correspondence to Maria McCormack Sobrino,
(Name of Attorney or Agent)
BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP,
12400 Wilshire Boulevard 7th Floor,
Los Angeles, California 90025
and direct telephone calls to

Maria McCormack Sobrino, (408) 720-8300.
(Name of Attorney or Agent)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full Name of Sole/First Inventor Sukendeep Samra

Inventor's Signature S S Samra. Date 11 September 2000

Residence Venice, California (City, State) Citizenship United Kingdom (Country)

Post Office Address 2500 Abbot Kinney Boulevard, No. 1
Venice, CA 90291 U.S.A.

APPENDIX A

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P0816 Rev 02/07/00 D2

APPENDIX B

Title 37, Code of Federal Regulations, Section 1.56
Duty to Disclose Information Material to Patentability

(a) A patent by its very nature is affected with a public interest. The public interest is best served, and the most effective patent examination occurs when, at the time an application is being examined, the Office is aware of and evaluates the teachings of all information material to patentability. Each individual associated with the filing and prosecution of a patent application has a duty of candor and good faith in dealing with the Office, which includes a duty to disclose to the Office all information known to that individual to be material to patentability as defined in this section. The duty to disclosure information exists with respect to each pending claim until the claim is cancelled or withdrawn from consideration, or the application becomes abandoned. Information material to the patentability of a claim that is cancelled or withdrawn from consideration need not be submitted if the information is not material to the patentability of any claim remaining under consideration in the application. There is no duty to submit information which is not material to the patentability of any existing claim. The duty to disclosure all information known to be material to patentability is deemed to be satisfied if all information known to be material to patentability of any claim issued in a patent was cited by the Office or submitted to the Office in the manner prescribed by §§1.97(b)-(d) and 1.98. However, no patent will be granted on an application in connection with which fraud on the Office was practiced or attempted or the duty of disclosure was violated through bad faith or intentional misconduct. The Office encourages applicants to carefully examine:

(1) Prior art cited in search reports of a foreign patent office in a counterpart application, and

(2) The closest information over which individuals associated with the filing or prosecution of a patent application believe any pending claim patentably defines, to make sure that any material information contained therein is disclosed to the Office.

(b) Under this section, information is material to patentability when it is not cumulative to information already of record or being made or record in the application, and

(1) It establishes, by itself or in combination with other information, a prima facie case of unpatentability of a claim; or

(2) It refutes, or is inconsistent with, a position the applicant takes in:

(i) Opposing an argument of unpatentability relied on by the Office, or

(ii) Asserting an argument of patentability.

A prima facie case of unpatentability is established when the information compels a conclusion that a claim is unpatentable under the preponderance of evidence, burden-of-proof standard, giving each term in the claim its broadest reasonable construction consistent with the specification, and before any consideration is given to evidence which may be submitted in an attempt to establish a contrary conclusion of patentability.

(c) Individuals associated with the filing or prosecution of a patent application within the meaning of this section are:

(1) Each inventor named in the application;

(2) Each attorney or agent who prepares or prosecutes the application; and

(3) Every other person who is substantively involved in the preparation or prosecution of the application and who is associated with the inventor, with the assignee or with anyone to whom there is an obligation to assign the application.

(d) Individuals other than the attorney, agent or inventor may comply with this section by disclosing information to the attorney, agent, or inventor.